SPRING OAT PRODUCTION

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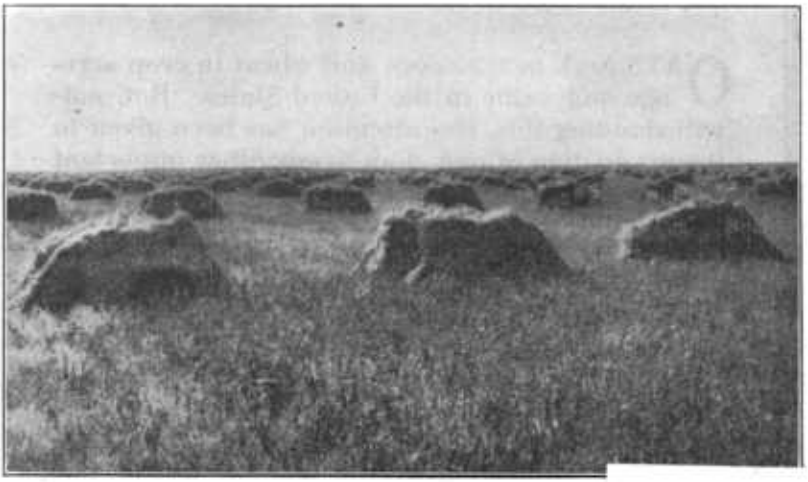

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OATS rank next to corn and wheat in crop acreage and value in the United States. But, notwithstanding this, less attention has been given to the production of oats than to any other important grain, so that yields often have been unsatisfactory and the crop sometimes unprofitable.

The essentials for success in oat production are—

Well-prepared land that is retentive of moisture and fairly fertile.

Good seed of suitable varieties, thoroughly cleaned and graded and treated for smut.

Early seeding with a grain drill.

The harvesting of the crop at the proper time.

Careful shocking and stacking so as to preserve the crop from injury by weathering.

Clean thrashing.

Directions for making the growing of oats more generally profitable are given in the following pages.

SPRING OAT PRODUCTION.

CONTENTS.

IMPORTANCE OF THE OAT CROP.

OATS constitute one of the most important grain crops in the North Temperate Zone. In the United States this crop is exceeded in acreage and value only by corn and wheat. It ranks far ahead of all other grain crops except wheat in Canada, and it is grown widely also in all the countries of northern Europe. The United States produces more oats than any other country in the world. The countries that rank next in importance in oat production in normal times are European Russia, Germany, Canada, France, and Austria-Hungary.

The average area annually devoted to oats in the United States in the five years from 1912 to 1916, inclusive, was 39,459,000 acres. This is approximately three-eighths of the acreage devoted to corn and three-fourths of the acreage devoted to wheat in the same years. The estimated average production of oats in these five years was 1,296,437,000 bushels, with an estimated farm value of $521,436,000. This latter figure is about three-tenths of the value of the corn crop and two-thirds of the value of the wheat crop in the same years. The accompanying map (fig. 1) shows that oats are grown most largely in the north-central United States. In fact, the 10 States of largest production lie wholly within this section. These States, in the order of their average production in the five years from 1912 to 1916, are Iowa, Illinois, Minnesota, North Dakota, Nebraska, Wisconsin, Ohio, Indiana, South Dakota, and Michigan. The produc-

tion in these States ranges from more than 187,000,000 bushels, in Iowa, to nearly 51,000,000 bushels, in Michigan.

SOILS ADAPTED TO THE PRODUCTION OF OATS.

In the production of oats proper climatic and cultural conditions are of more importance than the character or even the fertility of the

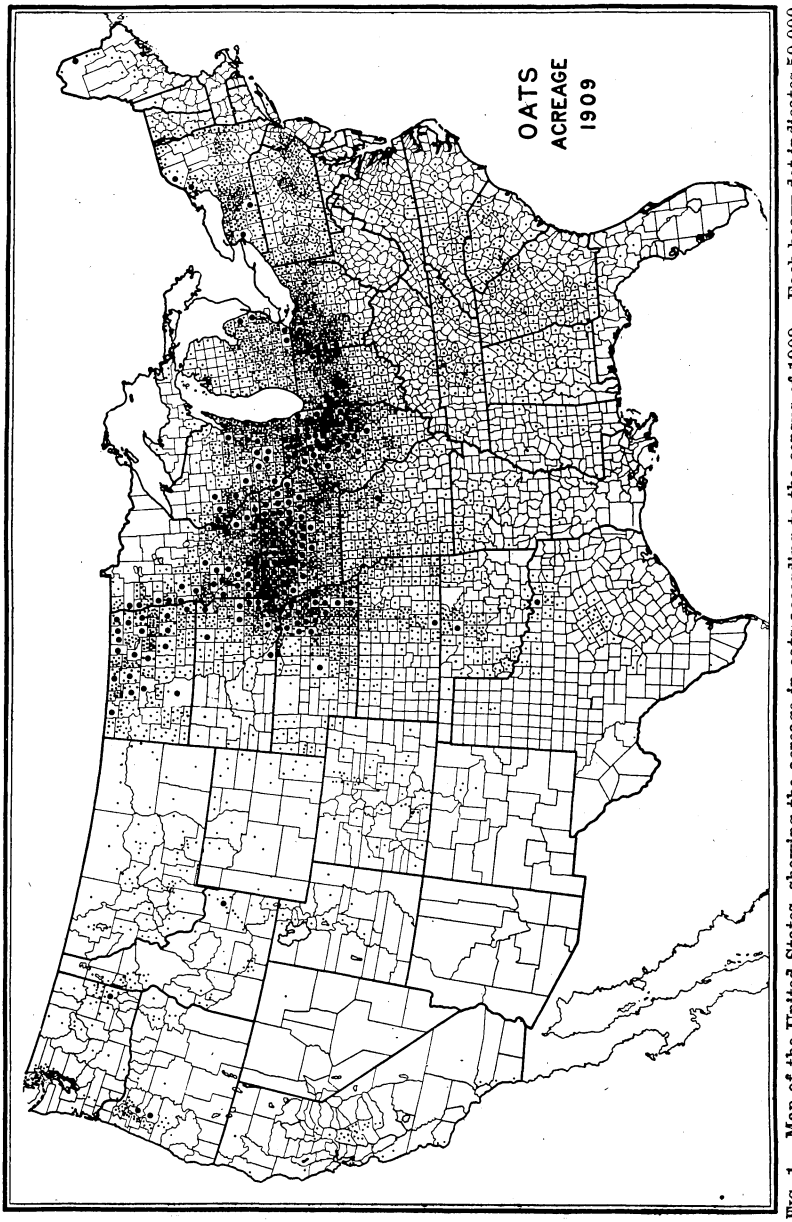

FIG. 1.—Map of the United States, showing the acreage in oats according to the census of 1909. Each heavy dot indicates 50,000 acres; each light dot indicates 5,000 acres.

soil. Owing to their greater water-holding capacity loam and clay soils usually produce better crops than sandy soils. Sandy land with plenty of plant food and a moderately stiff subsoil will grow good oats, but heavy, undrained clays are too wet and cold for the best growth of the crop. More water is required to produce a pound of dry matter in oats than in any other cereal; hence the necessity for growing this crop on land that naturally retains moisture or that is well filled with humus. On account of their liability to lodge, oats should not be grown on very rich soil or on low, undrained lands. Good drainage is essential also in the prevention of injury from plant diseases.

FERTILIZERS AND MANURES.

Though the oat crop is a vigorous feeder and will do better on poor soils than most other grain crops, the judicious use of fertilizers or manure is usually profitable. The fertilizer problem is made difficult, however, by the fact that on rich soil oats make a rank growth, which often results in lodging and in conditions favorable to rust and other diseases.

Unless the soil is very low in fertility the direct application of barnyard manure to the crop is seldom advisable. Much more satisfactory results usually can be obtained by applying the manure previous to growing some other crop in the rotation, such as corn. The oats then will get the benefit of a part of the manure and of the added humus in the soil, with less danger that a rank growth of straw will be made at the expense of grain production. On very poor soil a few loads of well-rotted manure may be applied some time previous to sowing oats. The manure should be spread as evenly as possible and should be well worked into the soil. The use of a small quantity of raw rock phosphate with the manure is usually advisable.

Of the three most important plant-food elements, nitrogen, phosphorus, and potash, phosphorus is the one most often present in insufficient quantities for the best production of oats. This is particularly true of some of the prairie soils in the upper Mississippi Valley, where a large portion of the oat crop is grown. Although phosphorus is usually the most important fertilizing element that can be added to the soil for the production of oats, small quantities of nitrogenous fertilizer often can be used to advantage. The oat crop makes most of its growth early in the season, when the weather is cool and before much of the nitrogen in the soil becomes available for plant food. For this reason the application of a small quantity of nitrogen in a readily available form will hasten its growth and result in materially increased yields. Potash usually can be applied more profitably to some other crop in the rotation, such as corn or wheat. This element

is usually present in large quantities in clay soils, but is often a valuable addition to sandy or gravelly ones. The application of 10 to 20 pounds of actual potash to the acre annually is usually sufficient on loam and clay soils, but on soils that are known to be rich in this material its use is unnecessary.

A good fertilizer for oats on the heavier loam and clay soils is one containing 50 pounds of nitrate of soda and 150 pounds of acid phosphate, applied at the rate of 200 pounds to the acre. On sandy and gravelly soils the addition of 20 to 40 pounds of muriate of potash to this combination is usually beneficial. The exact quantity to be applied and the proportion of the different fertilizing elements depend largely on the nature and the fertility of the soil and the price of the fertilizers. The straw of grain crops may be strengthened by the use of fertilizers containing potash and phosphorus, and in this way lodging sometimes may be prevented. Lodging in the principal oat-growing sections, however, is due oftener to the blowing over of the whole plant by heavy winds when the ground is soft from excessive rains than to actual weakness of the straw.

When the crop is desired for forage rather than for grain, the use of barnyard manure or fertilizers rich in nitrogen is often advisable, as nitrogenous fertilizers induce the rank growth necessary for the production of large yields of forage.

Liming alone is not likely to increase the yield of oats. On very sour soils or when used in connection with the plowing under of green-manure crops or stable manure lime may have a beneficial effect. Although the application of lime or fertilizers to oats may not be directly profitable, the increased yields from succeeding crops may often more than make up the deficiency. This is particularly true when clover or a grass crop is to follow the oats.

OATS IN THE ROTATION.

Among the factors that determine the place of the oat crop in the rotation are the effect of the preceding crop on the growth of the oats and the effect of the oats on the following crop. Ordinarily oats are not grown after a grass or clover crop, a cultivated crop being used to subdue the sod. In sections where new land is being brought under cultivation oats usually are grown on "old land," wheat and flax being the crops that ordinarily are grown on sod land if a cultivated crop such as corn or one of the sorghums is not used. When grown on sod land, especially where the sod consists wholly or in part of clover or alfalfa, oats are inclined to grow rank and lodge. Where there is less trouble from lodging, as in some of the irrigated sections of the West, oats may follow clover or alfalfa.

Oats are less influenced by the effect of the preceding crop than are most other grains, so that where wheat, barley, and oats are the

main crops, the rotation, if one is practiced, is arranged to suit the other grains rather than the oats. Where corn or some other cultivated crop is grown, oats usually follow the cultivated crop and are followed by grass or clover, which usually are sown with the oats.

COMMON ROTATIONS THAT INCLUDE OATS.

A common rotation in Iowa, Illinois, and other corn-belt States consists of corn, oats, and grass or clover. Usually this is a 5-year rotation, two crops of corn being grown in succession, followed by oats, with grass and clover seeded with the oats; the grass is allowed to remain for two years, either as meadow or pasture, and is then plowed up for corn. Sometimes the rotation is shortened to four years, either two years of corn and one each of oats and grass or one year each of corn and oats and two years of grass. The first of these two rotations is the common one where clover alone is used as the hay crop. Where winter wheat can be grown, it is customary to use it as a nurse crop for grass or clover. The common rotation where both oats and winter wheat are grown is corn, oats, winter wheat, and grass or clover for one or more years. In Maine and in some of the other potato-growing sections a common rotation consists of potatoes, oats, and clover, each one year. In the spring-wheat section, if corn is grown the common rotation is corn, wheat, oats, and grass. In some portions of the spring-wheat belt no rotation is practiced, particularly if corn and grass are not included among the staple crops. In the South oats occupy so small a portion of the cultivated area that they do not figure commonly in the rotation. In this section a good rotation that includes oats consists of corn, with cowpeas sown between the rows; oats, followed by cowpeas; and cotton. In the irrigated sections oats sometimes are grown in rotation with clover or alfalfa.

GROWING IN MIXTURES WITH OTHER CROPS.

Oats are sometimes grown in combination with other crops for the production of either hay or grain. In the United States the most common combination of this kind is oats and Canada field peas. Rape is often sown with oats, to be used as pasture for hogs or sheep after the oats are harvested. In Canada, barley and oats are commonly grown together, and other grains are sometimes included in the mixture.

Where peas are grown with oats the crop is used as pasture or cut for feeding green or for hay. A common rate of seeding is 1 bushel of peas and 1½ bushels of oats to the acre, though an equal mixture is often used, sowing from 2 to 3 bushels to the acre. Where vetch does well it is sometimes substituted for the peas. A common proportion is 2 parts of vetch to 1 of oats. The combination of a legume

with oats for pasture and soiling purposes increases both the yield and the feeding value of the crop, while the legume adds nitrogen to the soil.

Oats and barley grown together often yield more than either sown alone. This combination is a very popular one in Ontario, though it is not common in the United States. It is necessary to use an early variety of oats so that the two crops will ripen together. These crop mixtures are usually used for feeding on the farms where they are grown, as they are not readily marketable except as feed grain. The best yield is generally obtained from sowing 1 bushel each of oats and barley. Emmer, spring wheat, and other grains may also be grown with oats, but none of the combinations yield as well as the barley-oat mixture.

A small quantity of rape seed, 1 to 2 pounds, is often sown with oats. It is good practice, however, to sow the rape two or three weeks after the oats are sown, covering the seed by harrowing lightly. If sown at the same time as the oats it makes so much growth that it interferes with the harvesting of the oats. If the oats are cut with a rather high stubble, if the season is favorable the rape will at once start into vigorous growth and make excellent pasture for sheep and hogs. Sheep, in particular, do well on this pasture, as they glean any grain that may have been left by the binder. Rape sown in this way may also be cut for feeding green, or when sown with the oats or with oats and peas the entire crop may be cut green, thus furnishing a large yield of succulent feed.

CLEARING THE LAND OF WEEDS.

As oats start into growth early in the season and soon make a dense shade, they are one of the best crops for clearing land of weeds. For this purpose they should be sown rather more thickly than on land that is free from weeds. The crop may be cut for grain or for hay, as desired, but it should be harvested before many of the weeds that grow with it mature their seed. The land then may be pastured to keep down the later growth, or the weeds that develop after the oats are harvested may be cut with the mower or plowed under before they mature seed. If the field is plowed it should be disked or harrowed occasionally to destroy any weeds that start into growth. If fall grain is sown or if the land is used for a cultivated crop the next season, it will be practically free from annual weeds by the end of the second year.

USE AS A NURSE CROP.

Oats are used very commonly as a nurse crop for clover and grass and sometimes, in the irrigated sections, for alfalfa. Although not ideal for the purpose, as the foliage is rather too dense and the crop

draws too heavily on the soil moisture, good results usually are obtained. The sudden change from dense shade to full exposure to the sun when the oats are harvested sometimes injures the young clover and grass plants. In dry seasons oats may take the moisture from the soil so completely as to check severely the growth of crops sown with them. Either barley or wheat is more suitable for use as a nurse crop, making less shade and requiring less water. Where oats are used the selection of small, early varieties is advisable, because they grow less rank and take less water from the soil than the later, larger growing varieties. They also mature early enough to harvest before the hot weather, which is likely to injure the young grass. Less seed should be used where oats are sown as a nurse crop than when sown for other purposes. Drilling is preferable to broadcast seeding, as the space between the rows admits light and air to the grass and clover plants.

USE AS A COVER CROP.

Oats are used to some extent as a cover crop in orchards in the Northern States. They draw rather heavily on the soil moisture, thus checking the growth of the trees and causing the young wood to mature fully before cold weather. Oats make a dense cover and thus protect the soil from intense summer heat. They also furnish considerable winter protection, though the plants make a close mat on the ground after heavy frosts and do not hold snow as well as some other cover crops. The use of peas or vetch with the oats increases the value of the cover, as these crops add nitrogen as well as humus to the soil. The proper dates and rates of seeding for cover crops depend largely on the locality and the practice of the particular fruit grower who uses them.

PREPARATION OF THE SEED BED.

Less attention ordinarily is given to the preparation of the seed bed for oats than that for any other field crop. In the corn belt, where oats commonly follow corn, the seed is often sown broadcast without previous preparation of the land. It is then covered by disking and harrowing. Much better results are obtained, however, by disking the land before seeding, whether the seed is sown broadcast or is drilled. A good seed bed usually can not be prepared with fewer than two diskings and at least one harrowing. If the oats are to be sown on cornland on which the stalks are still standing, it is good practice to break the stalks before disking. This can be done readily, especially on a frosty morning, by dragging a heavy pole or iron rail broadside across the field. The stalks then can be cut with a disk harrow much better than if left standing. If the

disks of the disk harrow are sharp, they will cut the stalks into short pieces, which soon decay. It is never advisable to rake and burn stalks and other trash on cornfields that are to be sown to oats unless the quantity is so great that it can not possibly be covered by disking. This humus-making material should not be destroyed but should be worked into the soil. A disk harrow in operation on cornstalk land is shown in figure 2.

Oats always should be sown as early in the spring as the land can be worked, but proper preparation should not be sacrificed to gain a little time in getting the seed into the ground. Oats do best when sown in a rather firm seed bed, with 2 to 3 inches of loose, mellow soil on the surface. This can be obtained best on cornstalk land by breaking the stalks, double disking either by lapping half or cross disking, and thorough harrowing with a spike-tooth harrow. Lapping half with a disk harrow leaves the surface more nearly even than when the field is cross disked. The disks should be set to run 3 or 4 inches deep. After the seed bed is in good condition the seed should be sown and the field again harrowed. A spike-tooth harrow in use in completing the preparation of an excellent seed bed for oats is shown in figure 3.

FIG. 2.—Preparing a seed bed for oats on cornland by the use of a disk harrow.

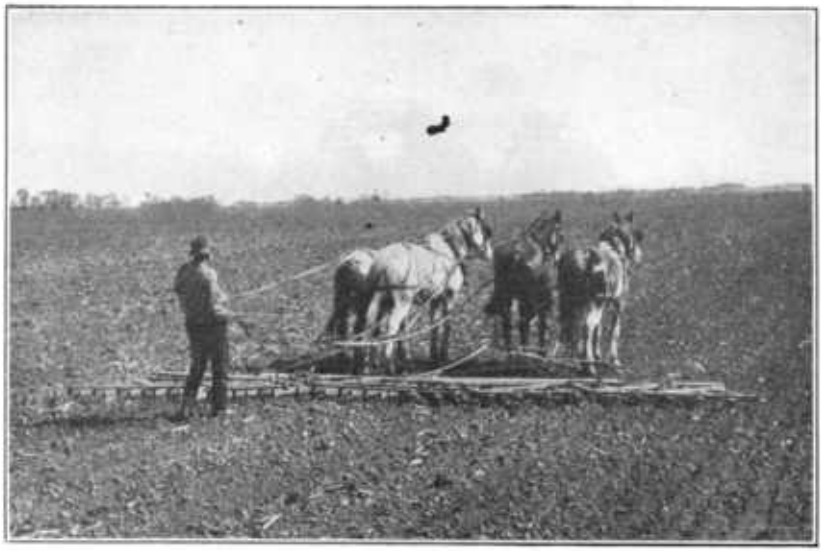

FIG. 3.—Completing the preparation of a good seed bed for oats on cornland with a spike-tooth or smoothing harrow.

The land seldom is plowed for oats that follow a cultivated crop. Spring plowing usually is not profitable, as there is little time to allow the subsurface to become compact and the land is rarely in proper condition to plow before the oats should be sown. Soils that are not likely to blow or run together sometimes can be plowed in the fall to advantage, particularly if grass seed is to be sown with the oats. A fine, smooth, mellow seed bed thus can be prepared. Fall-plowed land should be double-disked about 3 inches deep before seeding and harrowed both before and after seeding. A disk harrow in operation on fall-plowed stubble land is shown in figure 4.

PREPARATION OF THE SEED.

Seed oats should be screened and graded carefully before sowing. This work ordinarily is done with a fanning mill, the light oats and some of the trash being taken out by a current of air, while the small oats and most of the weed seeds are screened out. Ordinarily one-third or one-fourth of the oats should be taken out, but if the seed is very light a much larger proportion should be removed by the fans. Many of the small, light oats will not germinate at all, while others produce weak plants, which materially reduce the yield. Screening also greatly reduces the proportion of weed seed, thus preventing the spread of weeds and further favoring the growth of the oat crop. Figure 5 shows an uncleaned sample of oats unsuitable for seed and a cleaned sample with the weed seeds, trash, and light oats removed.

FIG. 4.—Disking fall-plowed stubble land to prepare a seed bed for spring-planted crops.

TREATING THE SEED FOR SMUT.

The yield of grain and the quality of the crop also can be materially increased by treating the seed for smut. An easy and effective method of treatment is to sprinkle the seed oats with a solution made by adding 1 pound of formaldehyde to 40 gallons of water.[1] After the smut balls and trash have been removed by fanning, the seed should be spread on a clean floor, thoroughly sprinkled, and shoveled over until all of the grain is well moistened. It should then be covered with blankets or canvas and allowed to stand for several hours. It can then be sown at once or spread out in a clean place to dry. The seed will run through the drill much more readily if dried before seeding. The rate of seeding should be somewhat increased, to allow for the swelling of the seed. The treated seed should not be put into sacks, bins, or machinery unless the smut spores in them have been killed by treatment with the formaldehyde solution.

SOWING THE SEED.

One of the greatest essentials in growing oats is to get the seed into the ground early. This crop grows best in cool climates and in

[1] A full description of this and other methods of smut treatment is contained in Farmers' Bulletin 507, entitled "The smuts of wheat, oats, barley, and corn." This bulletin may be obtained free from the Division of Publications, U. S. Department of Agriculture.

cool weather and often is injured materially by a few hot days when it is near maturity. Frosts or even hard freezes after the seed is sown seldom injure it, so that, as a rule, oats should be sown just as soon as the ground is in condition to work in the spring.

The exact date of seeding naturally depends on the locality and the season. In the South the seeding of spring oats begins in the latter part of January or early in February, and in the Northern States it is not completed until May. The best date in Kansas, Missouri, southern Illinois, and Kentucky ranges from March 10 to March 25. For Pennsylvania, Ohio, Indiana, central and northern Illinois, Iowa, and Nebraska the best date is usually from March 25 to April 15, though a somewhat later date sometimes may be necessary. In the Northern States seeding during the latter half of April is advisable whenever possible, though in favorable seasons seeding before the middle of the month often can be done to advantage, and in unfavorable ones in the extreme North May seeding is necessary. In the Rocky Mountain and Pacific States seeding is governed so largely by local conditions that no definite dates can be given. In some districts, owing to the distribution of the rainfall, late seeding may be more uniformly successful than early seeding.

RATE OF SEEDING.

The rate of seeding depends on the locality, the condition and fertility of the soil, the method of seeding, and the size of the seed.

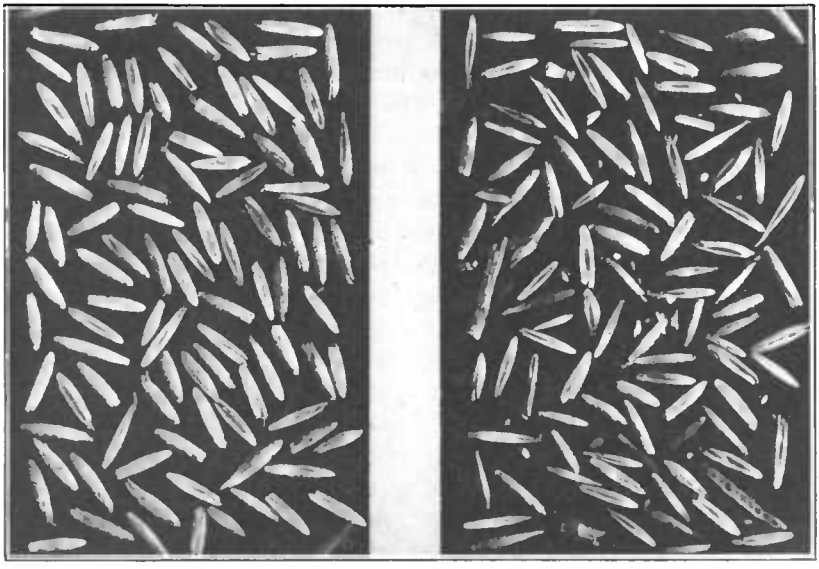

FIG. 5.—Sample of oats containing small kernels, trash, and weed seeds (right), and one of seed oats from the same lot suitable for sowing, the trash, weed seeds, and small, immature kernels having been removed.

As with other crops, less seed is required in dry than in humid sections. Fertile soils require less seed than poor ones, as on rich land the plants grow larger and tiller more. More seed should be sown on weedy land or on land not well prepared than on clean, mellow soil. Drilling requires less seed than sowing broadcast. More bushels of large-kerneled than of small-kerneled oats should be sown on an acre. The large-kerneled varieties usually grow ranker and the plants occupy more space than the small-kerneled ones, but the difference in the size of the plants does not equalize the difference in the thickness of the stand caused by the greater number of plants produced from a bushel of small-kerneled oats.

In general, the rate of seeding in the upper Mississippi Valley ranges from 8 to 12 pecks to the acre, but in the drier sections of the West this rate is reduced by half. In the irrigated sections 6 to 8 pecks is the common rate. Where the usual rate in broadcast seeding is 12 pecks, 10 pecks will be sufficient if the seed is drilled.

Many experiments have been conducted to determine the best rate of seeding in different localities. These experiments show, in general, that tillering depends very largely on the thickness of the stand and that within certain limits the plants on thinly seeded plats will tiller sufficiently to bring the number of stalks up to that produced by thick seeding. Thus, there is often little difference in the yield of grain or straw harvested from widely differing rates of seeding.

METHOD OF SEEDING.

The two common methods of seeding are drilling and sowing broadcast. The use of a drill has increased greatly in recent years, though some of the crop still is sown broadcast and a disk or smoothing harrow used to cover the seed. The ideal method of seeding is one that distributes the seed evenly in the ground and covers it to a uniform depth. Neither of these results is obtained in broadcast seeding and both are possible by drilling. Less seed is necessary, the depth of covering is more nearly uniform, the seed germinates more evenly, and its growth throughout the season is better when the seed is drilled. Clover and grass sown with the oats usually grow better in drilled than in broadcast grain. A grain drill in operation on well-prepared land is shown in figure 6.

The depth to which the seed should be covered depends on the nature of the soil and the quantity of moisture it contains. In moist soil shallow seeding is best, covering the seed to a depth of 1 to 1½ inches. In dry soils or in loose, sandy loams, which lose their moisture readily, deeper seeding is advisable. In the semiarid section the seed ordinarily should be sown deep enough to get it into soil with sufficient moisture for germination. This may require sowing as much as 3 inches deep. If sown broadcast, the seed should

FIG. 6.—Sowing oats with a grain drill on well-prepared land.

be covered by shallow disking or thorough harrowing. Usually, if the field has been double-disked or harrowed and is in good condition before seeding, harrowing twice will cover the seed sufficiently. At best, however, in broadcast seeding it is impossible to cover all the seed to the same depth; some of it is left on the surface and does not germinate at all, while some is covered so deep that its germination is delayed greatly.

TREATMENT AFTER SEEDING.

The yield of oats sometimes can be increased by treatment given after the crop is sown. The most important methods for thus increasing the yield include cultivation, spraying to kill weeds, and irrigation.

CULTIVATION.

On loose, sandy soil or on spring-plowed land germination and early growth sometimes can be hastened by rolling after seeding. On soils that are inclined to pack and bake, the roller should be used with caution, as its use is likely to increase this tendency. A light harrowing after rolling, to break the crust and hold the soil moisture, is beneficial.

The cultivation of small grain with a harrow or weeder seldom is practiced; but experiments indicate that it may be worth while, particularly in regions of light rainfall. If a harrow is used, the teeth should be slanted backward, so as not to pull out the young grain. Cultivation with a harrow is sometimes of advantage on

very weedy ground, even where the rainfall is ample, as the weeds are killed readily when small. The harrow should be used, however, only on dry fields and only after the young grain is well rooted.

Large weeds that develop with the crop, if not too numerous, often can be removed by pulling or cutting, without much injury to the oats. The gain from preventing the spread of the weeds more than repays the necessary loss from trampling in removing them. This should be slight, particularly in drilled grain.

SPRAYING TO KILL WEEDS.[1]

Several of the common annual weeds of grain fields can be kept in check by spraying with a chemical solution. The chemical kills the weeds without seriously injuring the grain or the young grass seeding. Common wild mustard is the weed most commonly controlled by spraying, but ragweed, kinghead, corn cockle, pigweed, smartweed, Canada fleabane (horseweed), marsh elder, cocklebur, wormseed mustard, and green tansy mustard also can be destroyed. Wild radish, chickweed, peppergrass, ball mustard, and black mustard are more resistant to the spray, but can be killed by repeating the treatment. Pennycress (Frenchweed), false flax, hare's-ear mustard, tumbling mustard, Indian mustard, and wintercress are not affected seriously by the spray, nor are any of the perennial weeds, such as Canada thistle, wild morning-glory (bindweed), curled dock, and perennial sow thistle. Grasses are not injured, but clover and alfalfa are damaged seriously and should not be sprayed.

Iron sulphate (copperas or green vitriol) is the most convenient and reliable material, using 100 pounds of granulated (sugar form) iron sulphate to 50 gallons of water. Copper sulphate (blue vitriol or bluestone) is also effective, using 12 to 15 pounds to 50 gallons of water. Common salt is serviceable, if the others can not be obtained, using one-third barrel (90 to 100 pounds) to 50 gallons of water. The usual application is 50 to 60 gallons of the solution per acre.

The time of spraying is very important. The work should be done early in the season, while the weeds are small and before they have formed flower buds. In the northern United States this will be usually from May 25 to June 10. If sprayed after the flower buds are formed, the weeds are almost sure to produce more or less seed.

Spraying should be done, if possible, on a quiet, sultry day when rain is not probable for at least 18 hours. On a very hot, dry day the spray dries off too rapidly. Spraying has not proved successful in

[1] This section on spraying to kill weeds has been prepared by Mr. L. W. Kephart, scientific assistant in weed investigations. Detailed directions for this work can be obtained upon application to the Office of Forage-Crop Investigations, U. S. Department of Agriculture.

the upper Great Plains area, owing to the prevailing high winds and low relative humidity.

Small patches of weeds can be sprayed with a bucket pump or knapsack sprayer, but for larger areas a good hand-operated force pump or a 2-wheel traction sprayer is necessary. Such an outfit with a suitable arrangement of nozzles for spraying a solid strip will cover 10 to 20 acres a day. The cost of spraying varies from $1.25 to $1.75 an acre, depending largely upon the convenience of the water supply. Usually the increase in the oat crop due to eliminating the weeds will at least cover the cost of spraying.

IRRIGATION.[1]

Oats require rather more water for their best growth than wheat, though varieties of both grains differ widely in this respect. The irrigation of oats is practiced to a considerable extent in the Rocky Mountain and North Pacific States, particularly in Montana, Idaho, Utah, and Colorado. Ordinarily water is applied in two irrigations, though three or four sometimes are given. When two applications are made, the first is usually just before heading begins; the second and much heavier one is applied when the grain begins to fill. Opinions vary greatly as to the supply of water needed for this crop, though 15 to 20 inches is probably the most profitable quantity. Where plenty of water is available much more is applied ordinarily. The quantity of water to be used depends upon the nature of the soil. The danger, especially where water is plentiful, is in overirrigation.

HARVESTING THE CROP.

CUTTING.

Oats usually are cut with a grain binder, though in the drier sections the header or the combined harvester and thrasher is used occasionally. A binder in operation in a field of oats in North Dakota is shown in figure 7. When the straw is very short, due to drought, or when the crop is badly lodged, cutting with a mower may be necessary. The grain may then be raked and put into cocks, which should be built so as to shed rain. The proper time to cut oats is when they are in the hard dough stage. Cut before this time the grain is not well filled, it shrivels in curing, and is light in weight. If allowed to become fully ripe before cutting, a considerable part of the crop shatters out and is lost in harvesting. The

[1] Farmers' Bulletin 863, entitled "Irrigation of grain," describes the methods of applying water to grain crops and gives other details of irrigation practice. Copies may be obtained free from the Division of Publications, U. S. Department of Agriculture.

FIG. 7.—Grain binder at work in an oat field in North Dakota.

danger of damage from storms also is increased. When a large acreage is to be harvested it is advisable to begin cutting soon after the grain passes out of the milk stage, as otherwise a considerable part of the crop is likely to become too ripe before it can be cut.

SHOCKING.

If the grain is ripe or in the hard dough stage when cut, it may be placed at once in round shocks, which should be capped to prevent damage from rain and dew. The best quality of grain can be obtained under these conditions. If the grain is green or if the bundles contain many weeds, they should be allowed to cure for a few hours before shocking, and then should be placed in long shocks, which may or may not be capped. Long shocks allow the sun and air to penetrate much more readily than round ones and are to be preferred when the grain is cut green or when conditions for curing are not favorable. If long shocks are capped properly, they protect the grain from weathering quite as well as round shocks. Grain that is wet from dew or rain should be allowed to dry before it is shocked. In sections where strong winds prevail during the harvest season capping is not advisable, as the caps blow off and the cap sheaves may be injured by contact with the ground.

A good round shock may be built by first setting up two bundles with the flat sides facing, the heads together, and the butts a few inches apart. These bundles should be jammed down hard into the stubble, so that they will stand firmly. Then set another bundle at each end of this pair, so that there will be four in a row. Next set one in the middle of each side. This leaves at each of the four corners a space in which a bundle should be placed. There are now 10

bundles in the shock, which is about the right number. If the grain is very dry, a few more bundles may be set around the shock where they seem to fit best. When the desired number of bundles is set up, the shock should be capped. One or two bundles may be used in capping, depending on the length of the straw and the dryness of the grain. One cap allows better circulation of air through the shock, while two caps afford greater protection from rain. The cap bundle is broken by supporting it with the butts on one knee and with one forearm and hand under it at the band, while the straw at each side is broken over just above the band with the other hand. The straw of about half the bundle is broken to the right with the right hand; then the hands are reversed and the remainder of the bundle is broken to the left with the left hand. If one cap is used, it always should be placed with the heads toward the direction of the prevailing winds. If two are used, they may be placed at right angles to each other. A well-built, round shock is shown in figure 8.

Long shocks may be built by setting up two bundles with the flat sides facing, the tops together, and the butts several inches apart to allow circulation of air between them. The next pair of bundles should be set up alongside the first in the same way, with the tops leaning slightly toward the first pair. The shock is completed by setting another pair at each end and then placing single bundles with the flat sides in the opening between each end pair. If desired, more

FIG. 8.—A well-built, round shock of oats, capped to protect most of the grain from weathering.

than 10 bundles may be placed in long shocks. In capping long shocks the first bundle should be put on with the butts pointing in the direction from which the prevailing winds come and covering the heads of the bundles in that end of the shock as completely as possible. The second cap should then be laid on the other end of the shock in the same manner, with the heads overlapping those of the first. Two bundles will cover an ordinary long shock with considerable overlap, but if the shock is very large more than two caps may be needed. A long, uncapped shock is shown in figure 9.

STACKING.

Whether oats should be stacked or allowed to remain in the shock until they are thrashed depends very largely on local conditions. If they can be thrashed from the shock after they are cured but before they are injured by weathering, the best course to pursue depends on the relative cost of shock and stack thrashing. Investigations show that stacking adds about 1 to $1\frac{1}{2}$ cents a bushel to the cost of producing oats. As thrashing outfits are often not available when they are wanted and as consequently the grain is likely to be injured by weathering, stacking is generally advisable, particularly in the humid section.

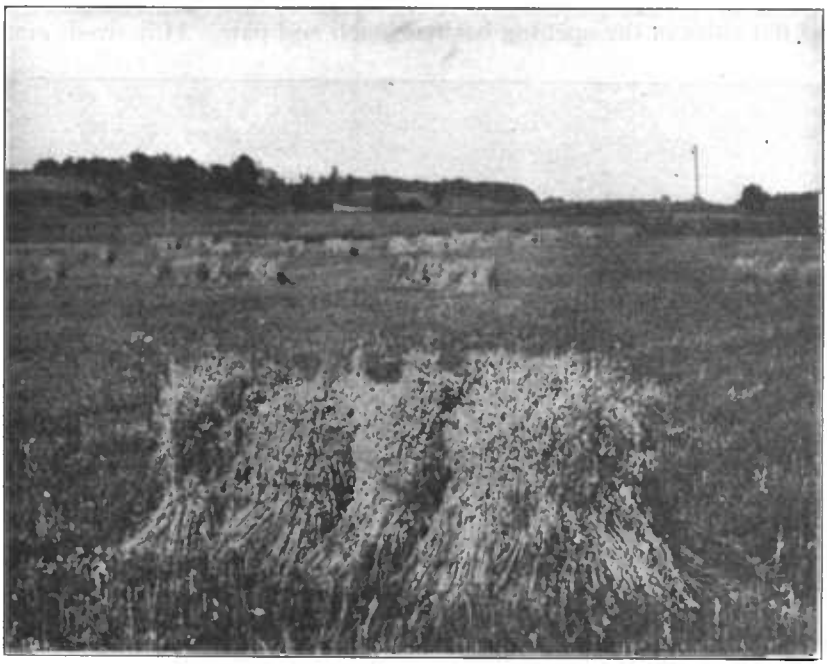

FIG. 9.—A long, uncapped shock of oats in which practically all the grain is exposed to the weather.

Where grain is stacked, it is important that the stacks be well built. If the stacks are put up so carelessly that they will not shed water, the grain might better be allowed to stand in the shocks. The bottoms of the stacks should be raised from the ground slightly by laying down old rails or other material to keep the straw from coming in contact with the earth, thus preventing the absorption of moisture from below. The shape of the stack is less important than the manner in which the bundles are laid, though round stacks probably shed water better than the long ricks sometimes built.

Stacking should be begun as soon as the grain is well cured in the shock, in about 10 days to 2 weeks after cutting. Round stacks are usually about 10 feet in diameter at the base. The usual plan is to build four stacks in a setting, in pairs 6 feet apart.

First build a large, round shock about 8 feet in diameter. Then place two layers of bundles, one directly on top of the other, with the heads resting against the shock and the butts forming the 10-foot base of the stack. Make the next row with the butts just covering the bands of the outer row. In the same manner lay rows of bundles, like shingles, until the center is reached, overlapping the rows a little more toward the center of the stack. When the first layer is completed, begin again at the outside and build toward the center.

Shocked bundles have slanting butts, because they are set in the shock with a slight slant instead of exactly upright. In building the outside rows around the stack lay the long edge of the butt on top and projecting beyond the lower bundle. In this way the diameter of the stack is gradually increased, forming the bulge. After a height of 7 or 8 feet is reached lay the outer bundles with the long edge of the butt beneath and just covering the inner edge of the layer just completed. In this way the diameter is gradually decreased and the stack is tapered slowly to a point.

Always keep the middle of the stack high and firmly tramped down. Do not tramp the outer layer at all. Keeping the middle high gives all the bundles a slant toward the outside and helps to shed rain. At the peak, where the bundles overlap, fasten a capsheaf securely by setting it on a sharpened stake driven into the top of the stack. A well-built stack 10 feet in diameter should be 20 to 25 feet high.

THRASHING.

As previously stated, it is cheaper to thrash directly from the shock if the work can be done while the grain is still in good condition. Thrashing from the shock is often subject to delay from rains, however, as the work must wait until the bundles are dry. This may mean the loss of one or even two or three days after heavy rains. On the other hand, if the grain is stacked, thrashing may be resumed

almost as soon as the rain stops. Grain may be thrashed from the shock either before or after it has gone through the sweat. If it is thrashed before it goes through the sweat, it will sweat in the bin, but if it is dry when thrashed it will not be injured. If the grain is damp when thrashed, it sweats too much and is likely to become hot and be damaged by bin burning. Stacked grain should be allowed to go through the sweat before it is thrashed.

The separator should be well cleaned before thrashing is begun, particularly if it has come from a neighbor's farm where a different variety of oats is grown or if some other grain has just been thrashed. Cleaning the separator also prevents the bringing of weed seeds from other farms. The operation of the machine should be watched carefully to see that all the grain is removed from the straw. It is much easier to do a clean job of thrashing when the grain is dry than when it is moist.

The straw should be run into the mow, where it can be kept under cover or, if it must be stacked outside, the stack should be built carefully so that it will shed water. Oat straw is a valuable roughage for live stock, being much better for this purpose than the straw of wheat or barley. It is also of value for bedding and the making of manure, if it is not all needed for feed.

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